OXFORD

INTERNATIONAL AQA EXAMINATIONS

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

OXFORD AQA INTERNATIONAL A-LEVEL

BIOLOGY (9610)

Unit 1: The diversity of living organisms

Monday 15 May 2017 Morning Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

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Answer **all** questions in the spaces provided.

0 1 There are 82 species of polychaete annelid worms (bristle worms) living in the Black Sea near the coast of Romania. *Nereiphylla paretti* and *Nereiphylla rubiginosa* are two of these species.

Table 1 gives a partial taxonomy of *Nereiphylla paretti*.

Table 1

Taxon	**Name**
Kingdom	
Phylum	Annelida
	Polychaeta
	Phyllodocida
Family	Phyllodocidae
Genus	*Nereiphylla*
Species	*paretti*

0 1 . 1 Complete **Table 1** by writing the correct answers in the **three** blank boxes.

[2 marks]

0 1 . 2 Describe **one** method scientists could use to find out if *Nereiphylla paretti* and *Nereiphylla rubiginosa* are two separate species.

[2 marks]

0 1 . 3 There are seven taxonomic groups in **Table 1**.

How many of these groups do *Nereiphylla paretti* and *Nereiphylla rubiginosa* have in common?

[1 mark]

5

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0 2 The biodiversity of an area can be represented by an index of diversity.

One example of an index of diversity is:

$$d = \frac{N(N-1)}{\sum n(n-1)}$$

0 2 . 1 What do **N** and **n** represent in the above index of diversity?

[1 mark]

N = _____

_____

n = _____

_____

0 2 . 2 Give **one** advantage of using an index of diversity for an area rather than measuring the species richness of the area.

[1 mark]

_____

_____

_____

0 2 . 3 Give **three** examples of human activity that reduce biodiversity.

For each example, explain how the activity reduces biodiversity.

[3 marks]

Example 1 _____

Explanation _____

_____

Example 2 _____

Explanation _____

_____

Example 3 _____

Explanation _____

_____

5

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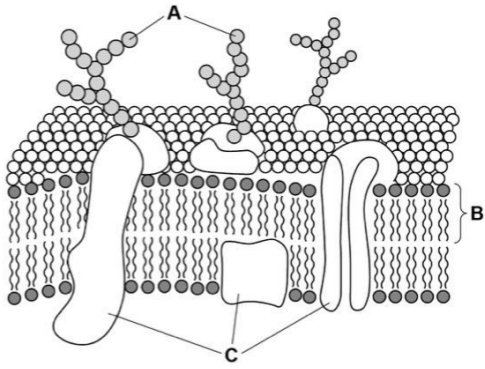
0 3 **Figure 1** shows the fluid-mosaic model of the cell-surface membrane.

Figure 1



0 3 . 1 In **Figure 1**, **A**, **B** and **C** are different types of molecule.

Name molecules **A**, **B** and **C**.

[3 marks]

A _____

B _____

C _____

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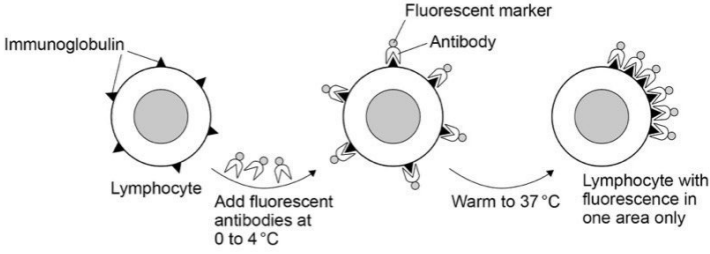
0 3 . 2 Lymphocytes are a type of white blood cell.

Scientists investigated the movement of substances in the cell-surface membranes of lymphocytes.

Lymphocytes have molecules of a substance called immunoglobulin attached to their cell-surface membranes. The scientists added proteins called antibodies specific to immunoglobulin. They also attached a fluorescent marker molecule to the antibody molecule.

Figure 2 shows the scientists' method and their results.

Figure 2



Suggest why the fluorescence was able to move at 37 °C but **not** at 0 to 4 °C.

Use your knowledge of the fluid-mosaic model of the cell-surface membrane in your answer.

[2 marks]

5

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0 4 In male animals, cell division in the testes produces gametes called sperm cells.

Figure 3 shows the chromosomes from a cell in the testis of a male fruit fly.

The cell is about to divide.

Figure 3

0 4 . 1 Name the type of cell division that produces sperm cells.

[1 mark]

0 4 . 2 How many chromosomes will there be in the sperm cell of a fruit fly?

[1 mark]

0 4 . 3 All sperm cells are genetically different. There are three processes in sperm production that cause genetic variation:

- independent assortment
- mutation
- crossing over.

If mutation and crossing over did **not** occur, independent assortment in the fruit fly could produce 2^4 genetically-different types of sperm cell.

In humans, the diploid chromosome number is 46.

How many genetically-different types of human sperm cell could be produced by independent assortment?

[1 mark]

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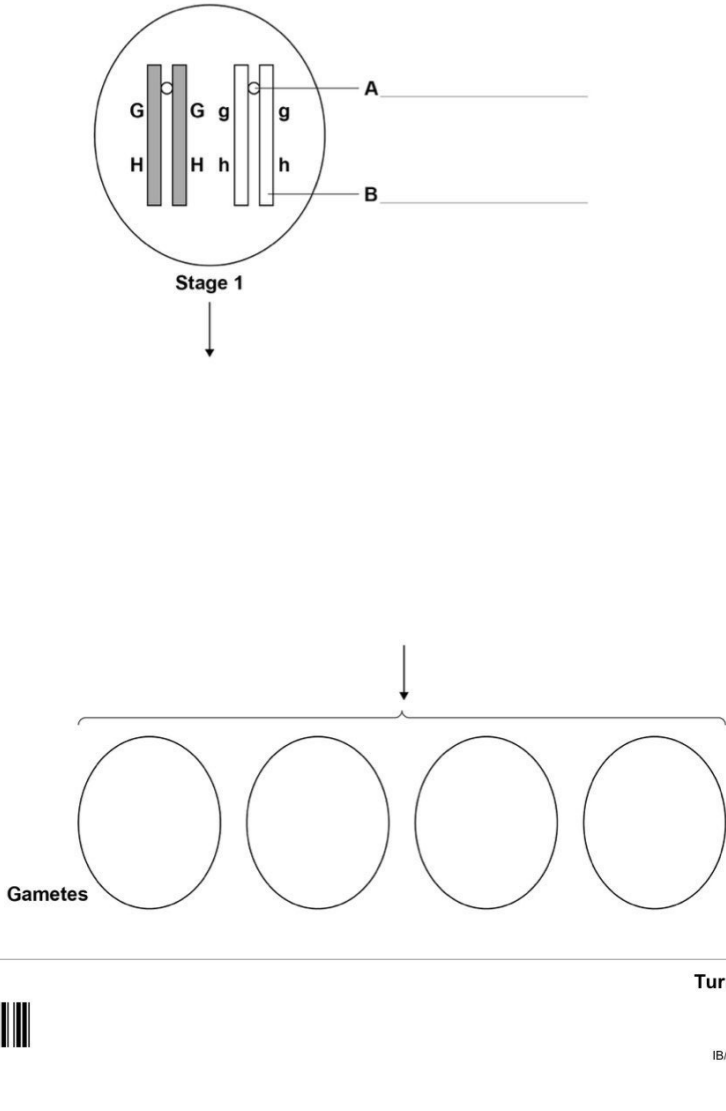
0 4 . 4 Crossing over increases genetic variation in the gametes.

Figure 4 shows some stages in gamete production. **G** / **g** and **H** / **h** are two pairs of alleles.

- Label structures **A** and **B** in **Stage 1**.
- Complete **Figure 4** to show how crossing over increases genetic variation in the gametes.

[4 marks]

Figure 4



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0 5 Microscopes are important tools in the study of cells.

0 5 . 1 Give **one** advantage and **three** disadvantages of using a transmission electron microscope, compared with a light microscope, when studying cell structure.

[4 marks]

Advantage _____

_____

_____

Disadvantage 1 _____

_____

_____

Disadvantage 2 _____

_____

_____

Disadvantage 3 _____

_____

_____

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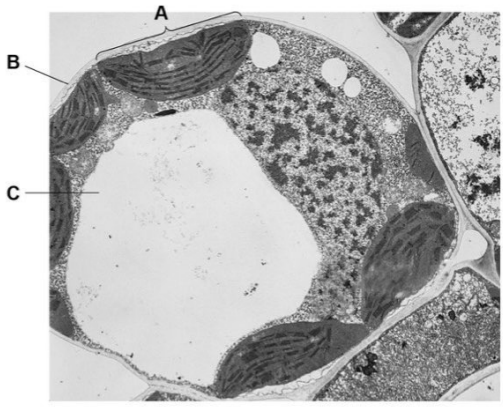
0 5 . 2 **Figure 5** is a photograph of a section through a cell from a plant leaf.
The photograph was produced using a transmission electron microscope.

Figure 5



Complete **Table 2** by naming parts **A**, **B** and **C** in **Figure 5** and giving **one** function for each part.

[6 marks]

Table 2

Part of cell	Name	Function
A		
B		
C		

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There are no questions on this page

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ANSWER IN THE SPACES PROVIDED

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0 6 Catalase is an enzyme that catalyses the following reaction:

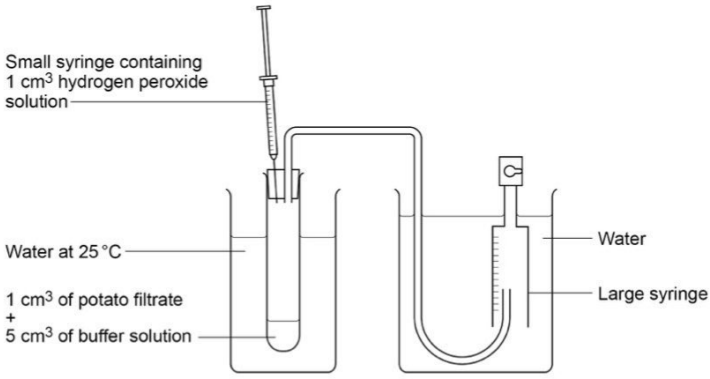
hydrogen peroxide ⟶ water + oxygen

Some students investigated the effect of pH on the activity of catalase from potatoes.

The students:

1. ground up 180 grams of potato tissue in 100 cm^3 of water
2. filtered the mixture and used the filtrate as their source of catalase
3. put 1 cm^3 of filtrate and 5 cm^3 of a buffer solution at pH2 into a boiling tube
4. set up the apparatus as shown in **Figure 6**
5. after 5 minutes, added 1 cm^3 hydrogen peroxide solution from the small syringe
6. collected the oxygen gas that was given off in 1 minute in the large syringe
7. measured the volume of oxygen using the scale on the large syringe
8. repeated steps 3 to 7 another 4 times
9. repeated steps 3 to 8 at eight more pH values.

Figure 6


Small syringe containing 1 cm3 hydrogen peroxide solution
Water at 25 °C
1 cm3 of potato filtrate + 5 cm3 of buffer solution
Water
Large syringe

0 6 . 1 The students controlled the temperature by placing the boiling tube in a beaker of water at 25 °C.

Explain why it was necessary to control the temperature.

[2 marks]

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Table 3 shows the students' results.

Table 3

pH	Volume of oxygen released / cm^3 min^{-1}						± Standard deviation
	1	2	3	4	5	Mean	
2	0.0	0.0	0.0	0.0	0.0	0.0	± 0.00
3	0.8	0.4	1.0	0.6	0.2	0.6	± 0.32
4	2.8	3.0	2.8	2.0	2.4	2.6	± 0.40
5	4.2	5.2	4.2	5.0	5.4	4.8	± 0.57
6	7.0	6.2	6.6	6.4	6.8	6.6	± 0.32
7	3.6	6.9	5.2	5.0	5.4	5.2	± 1.18
8	5.8	6.0	5.2	5.2	5.4		± 0.36
9	2.0	2.4	2.2	2.6	2.8	2.4	± 0.32
10	1.0	1.2	0.8	1.4	1.6	1.2	± 0.32

0 6 . 2 Calculate the mean volume of oxygen released at pH8.
Give your answer to an **appropriate** level of precision.

[2 marks]

Mean volume of oxygen released at pH8 = _____ cm^3 min^{-1}

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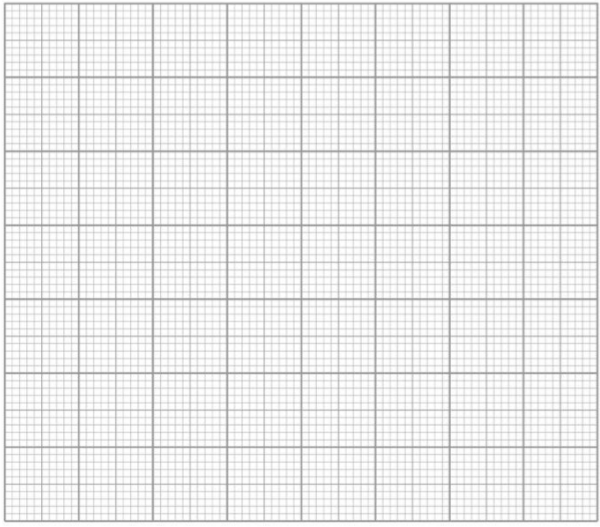
0 6 . 3 On **Figure 7**, draw a graph to show the effect of pH on the activity of catalase.

- Use the mean values of oxygen release given in **Table 3**
- Include the value you calculated in Question **06.2**
- Draw a suitable line of best fit.

[4 marks]

Figure 7



0 6 . 4 The students concluded that the mean value at pH7 was anomalous.

Give evidence for this conclusion from **Table 3** and your graph in **Figure 7**.

[2 marks]

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0 6 . 5 Estimate the optimum pH for the catalase activity.

Use information from your graph in **Figure 7**.

[1 mark]

0 6 . 6 No oxygen was released at pH2.

Give the reason why.

[1 mark]

12

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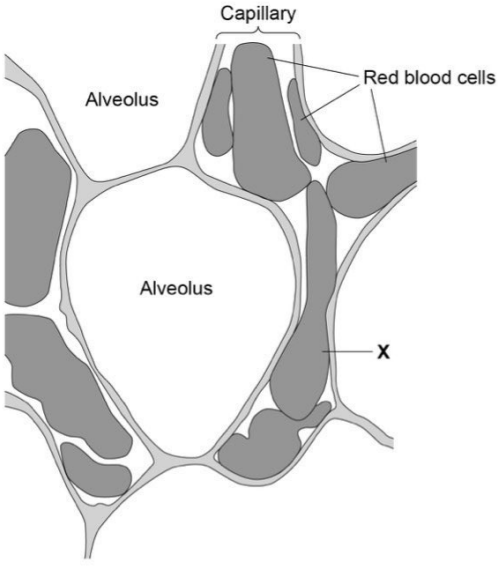
0 7 **Figure 8** shows a section through human lung tissue.

Figure 8



0 7 . 1 The red blood cells in **Figure 8** differ in shape.

Suggest **one** reason for this.

[1 mark]

0 7 . 2 The maximum diameter of the red blood cell labelled **X** is 8 micrometres.

Calculate the magnification of **Figure 8**.

[2 marks]

Magnification = _____

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0 7 . 3 Red blood cells contain haemoglobin. Haemoglobin has a high affinity for oxygen.

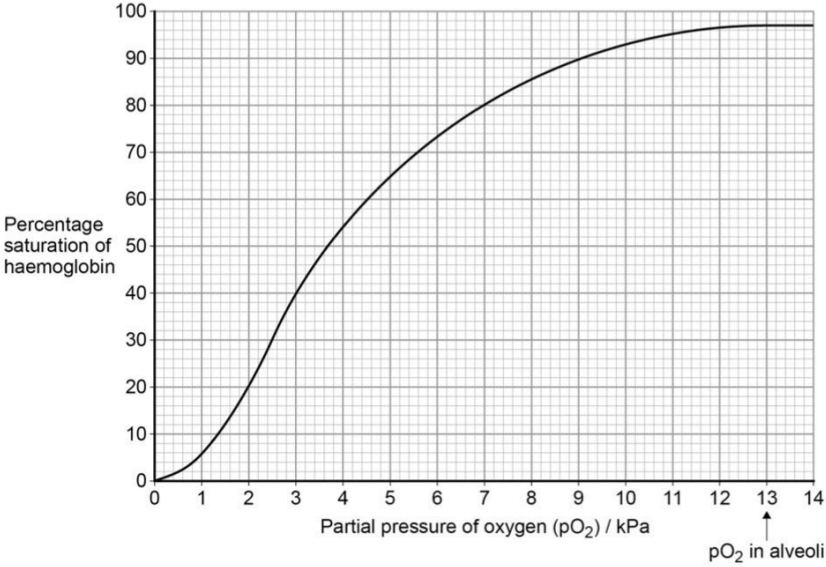
This causes a high rate of diffusion of oxygen from the alveoli into the blood.

Give the reason why.

[1 mark]

0 7 . 4 **Figure 9** shows the dissociation curve for oxyhaemoglobin in the blood of a person at rest.

Figure 9



The partial pressure of oxygen in resting skeletal muscle is 2.5 kPa.

Use information from the graph to determine the percentage saturation of haemoglobin in the blood leaving the resting muscle.

[1 mark]

Percentage saturation = _____ %

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0 7 . 5 Blood leaving the lungs contains 20 cm^3 of oxygen per 100 cm^3 of blood. This blood is 97% saturated with oxygen.

Calculate the volume of oxygen released per 100 cm^3 of blood as it passes through the resting muscle.

[2 marks]

Volume of oxygen released = _____ cm^3

0 7 . 6 During exercise, a person produces more carbon dioxide than at rest and the temperature of the person's blood increases. Both of these factors displace the oxyhaemoglobin dissociation curve, shown in **Figure 9**, to the right.

Explain the advantage of this to a person during exercise.

[2 marks]

_____

_____

_____

_____

_____

9

Turn over for the next question

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0 8 Glucose, fructose and maltose are reducing sugars. Sucrose is a non-reducing sugar. All of these sugars are found in plant cells.

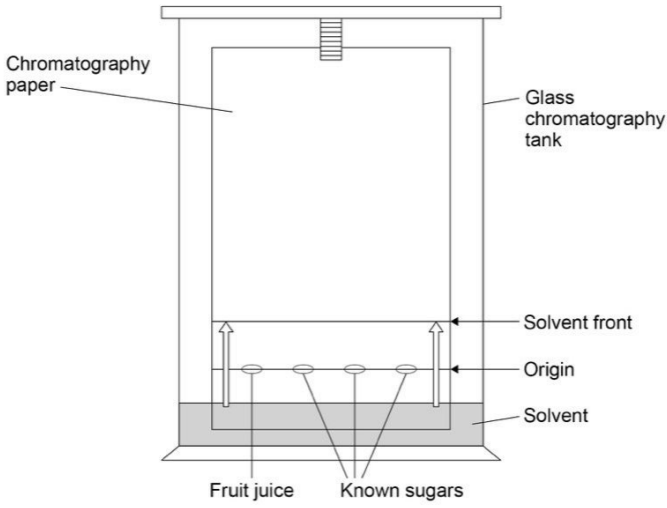
0 8 . 1 Describe chemical tests you could do to show that a sample of fruit juice contains reducing sugar **and** contains non-reducing sugar.

[3 marks]

0 8 . 2 Some students separated the sugars in the fruit juice using paper chromatography.

Figure 10 shows how the students set up the chromatography apparatus.

Figure 10



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Suggest reasons for each of the following steps in the students' method:

[4 marks]

Step 1 The origin line was drawn on the paper in pencil, **not** ink.

Step 2 The level of the solvent surface in the chromatography tank was at least 2 cm below the origin.

Step 3 A very small volume of fruit juice was added to the origin and dried with a hairdryer before adding more fruit juice.

Step 4 When the chromatography paper was removed from the tank, the position of the solvent front was marked **immediately**.

Question 8 continues on the next page

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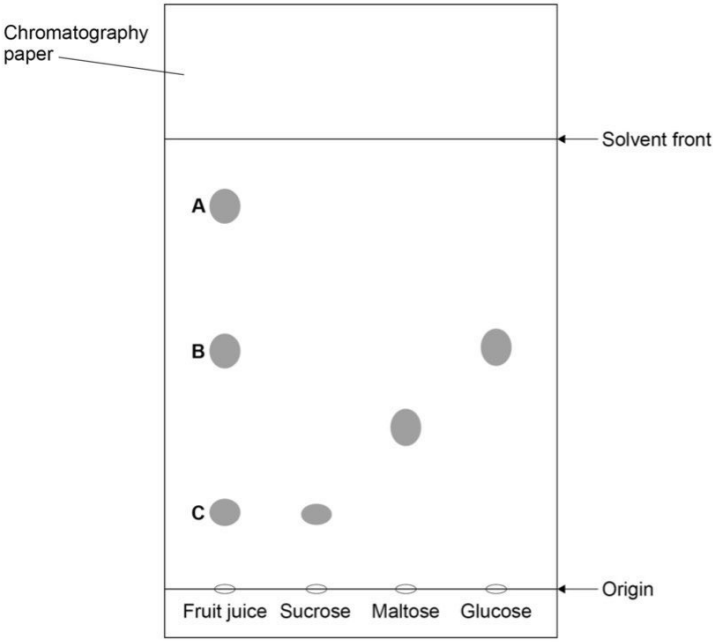
Figure 11 shows the students' results.

Figure 11



0 8 . 3 **Figure 11** shows that there were three sugars, **A**, **B** and **C**, in the fruit juice.

Calculate the R_f value of sugar **A**.

[2 marks]

R_f value of sugar **A** = _____

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0 8 . 4 **Table 4** gives the R_f values of four sugars for the solvent used by the students.

Table 4

Sugar	R_f value
Fructose	0.86
Glucose	0.57
Maltose	0.40
Sucrose	0.20

Use information from **Figure 11** and **Table 4** to identify sugars **A**, **B** and **C**.

[1 mark]

A _____

B _____

C _____

0 8 . 5 Scientists measured the R_f values of the sugars using two different solvents, **1** and **2**. **Table 5** shows the scientists' results.

Table 5

Sugar	R_f values	
	Solvent 1	Solvent 2
Fructose	0.51	0.25
Glucose	0.39	0.18
Maltose	0.36	0.11
Sucrose	0.39	0.14

The scientists concluded that **Solvent 2** was the better of these solvents for separating glucose and maltose.

Use suitable calculations to explain why the scientists made this conclusion.

[2 marks]

_____

_____

_____

_____

_____

12

Turn over ►

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0 9 Read the following passage.

DNA and mRNA are both needed for protein synthesis.

A molecule of DNA consists of two complementary polynucleotide chains held together by weak bonds between pairs of organic bases. There are four types of organic base in DNA: adenine, cytosine, guanine and thymine. The sequence of these bases, in part of the DNA molecule called a gene, determines the primary structure of a polypeptide.

Gene expression involves the transcription of the gene's DNA into mRNA. The mRNA is then used as a template for the synthesis of a polypeptide. In eukaryotic cells, the initial pre-mRNA transcript is usually modified, in a process called post-transcriptional modification, to form the functional mRNA molecule.

The functional mRNA molecule is then translated using ribosomes.

Use information from the passage and your own knowledge to answer the questions.

0 9 . 1 A molecule of DNA consists of two polynucleotide chains (line 2).

Draw a simple, labelled diagram to show the structure of **one** DNA nucleotide.

[2 marks]

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0 9 . 2 Name the type of weak bonds (line 3) that hold together the two polynucleotide chains of DNA.
Tick (✓) **one** box.

[1 mark]

Covalent ☐

Disulfide ☐

Hydrogen ☐

Ionic ☐

0 9 . 3 Both DNA and mRNA are polynucleotides.

Complete **Table 6** to give **two** differences between the structure of DNA and the structure of mRNA.

[2 marks]

Table 6

DNA	mRNA
1	1
2	2

0 9 . 4 Cytochrome c is a protein found in mitochondria.
The initial transcript (pre-mRNA) of the human cytochrome c gene has a length of 2441 nucleotides.

Give the maximum number of amino acids this transcript could code for.

[1 mark]

_____

Question 9 continues on the next page

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0 9 . 5 The actual length of a molecule of human cytochrome c is 104 amino acids.

Explain why the actual length is much shorter than the answer you gave in Question **09.4**.

[2 marks]

0 9 . 6 The synthesis of cytochrome c takes place on ribosomes (line 12).

In human cells, most ribosomes occupy a fixed position.
In bacterial cells, the ribosomes are not in a fixed position.

What causes this difference?

[1 mark]

0 9 . 7 The cytochrome c molecule contains one polypeptide chain.

Cytochrome c has a primary, a secondary and a tertiary structure.

Give the reason why cytochrome c **cannot** have a quaternary structure.

[1 mark]

10

END OF QUESTIONS

Figure 5: © BIOPHOTO ASSOCIATES/Getty Images.

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